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09/839,610	04/23/2001	Joseph Anthony Kraft	11777.00039	1477

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EXAMINER	
FERRIS III, FRED O	

ART UNIT	PAPER NUMBER
2128	

DATE MAILED: 10/04/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/839,610	KRAFT ET AL.	
	Examiner	Art Unit	
	Fred Ferris	2128	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 April 2001*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-29* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *16-29* is/are allowed.

6)☒ Claim(s) *1-15* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *14 June 2002* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *08/16/01*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. Claims 1-29 have been presented for examination based on applicant's disclosure filed on 23 April 2001. Claims 1-15 have been rejected by the examiner. Claims 16-29 are allowable over the prior art of record.

Drawings

2. The formal drawings submitted on 14 June 2002 have been approved by the examiner.

Claim Interpretation

3. It is noted that the term "bucket" and "blades", and the term "nozzles" and "vanes", are used in an equivalent sense in the art by the various manufacturers and designers of gas turbine engine components. Accordingly, the examiner has applied prior art rejections with this equivalence in mind.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claims 8, 9 and 15 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. *The claim(s) contains subject matter which was not described in the specification in such a way as to enable one*

skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Specifically, claims 8 and 15 recite a limitation relating to "an agent for cooperating with the simulation module and the optimizer to create the internal cooling geometry" while claim 9 recites "wherein the agent ***calculates*** *a plurality of geometric properties of the solid model" which have not been sufficiently disclosed in the specification. While the specification makes reference to "step 102" where system flow passes to an "automated geometry and a finite element mesh generation algorithm* ***or*** *agent" (page 14, paragraph 2), and an "automated geometry and a finite element mesh creation agent defining the initial geometry" (page 24, paragraph 2), there is no sufficient teaching that would allow a skilled artisan to realize the claimed "agent" for calculating geometric properties of the solid model or the cooperation between simulation module and optimizer.*

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. ***Claims 1-15 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.***

Per independent claims 1 and 11: These claims include limitations relating to a ***simulation module*** *(simulator) forming a model of the bucket, and an* ***optimizer*** *for comparing parameters and "automatically" modifying the geometry. MPEP 2171 requires the following:*

2171 Two Separate Requirements for Claims Under 35 U.S.C. 112, Second Paragraph

The second paragraph of 35 U.S.C. 112 is directed to requirements for the claims:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

There are two separate requirements set forth in this paragraph:
(A) the claims must set forth the subject matter that applicants regard as their invention; and
(B) the claims must particularly point out and ***distinctly define the metes and bounds of the subject matter that will be protected by the patent grant****.*

The first requirement is a subjective one because it is dependent on what the applicants for a patent regard as their invention. The second requirement is an objective one because it is not dependent on the views of applicant or any particular individual, but is evaluated in the context of whether the claim is definite — i.e., whether the scope of the claim is clear to a hypothetical person possessing the ordinary level of skill in the pertinent art.

In this case, applicant's specification defines the claimed "simulation module" (simulator) as consisting of a finite element analysis module realized by commercially available software (ANSYS, NASTRAN – page 11, paragraph 2), and boundary condition software (GHST, SIESTA – page 12, paragraph 2). The "optimizer" module is subsequently defined as consisting of the commercially available ISIGHT CAO software (page 13, paragraph 3). The examiner submits that claims 1-15 do not ***distinctly define the metes and bounds of the claimed subject matter*** *because it is unclear specifically where applicants claimed invention begins, and the prior art (i.e. commercially available software) leaves off relative to the simulation and optimization processes. In general, the language of the claims 1-15 fails to point out specifically what is* ***included*** *or* ***excluded*** *by the language of the claims and a person of ordinary skill in the art would be at odds to determine the exact scope of the claim.*

In dependent claims 8 and 15 the term "agent for cooperating with the simulation module" is unclear because the exact nature of the "cooperation" between the agent and simulation module is undefined, and in claim 10 the term "network coordinating the simulation module" is also unclear since the coordination between the network and simulation module is undefined.

Dependent claims inherit the deficiency of the claims from which they depend.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

6. Claims 1-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over "Domain Composition Method for Associating Geometric Modeling with Finite Element Modeling", J.J. Cox et al, ACM 089791-427-9/91/0006/0443, ACM 1991 in view of "Use of Fuzzy Logic to Describe Constraints Derived From Engineering

Judgment in genetic Algorithms", R. Pearce et al, IEEE Transactions on Industrial Electronics Vol. 43, No. 5, October 1996.

Independent claims 1 and 11 are drawn to:
*system for **determining internal cooling geometry of turbine engine bucket** defined by variables comprising:*
***simulation module (simulator)**: forming model of bucket's cooling geometry, and simulation turbine engine internal thermal environment within the turbine engine, and outputting predicted bucket performance parameter*
***optimizer**: comparing performance criterion and automatically modifying bucket cooling geometry, outputting attribute data*

Regarding independent claims 1 and 11: Cox teaches that finite element modeling of geometric properties can be applied to a structure and that geometric properties can be meshed to create a geometrically accurate meshed simulation model that includes coupling conditions, constraint conditions, variables, and boundary conditions of a modeled component. (Abstract, Sections 1.2-2.2, 3.2.2, 4.0) More importantly, Cox specifically discloses an analysis model of a turbine blade (bucket) using geometric primitives that are meshed including the cooling hole primitives which model the heat conduction (thermal environment) of the blade through the cooling passages. (Section 4.0, page 451, last paragraph, and Figure 21) Cox further discloses automatic refinement (modification) of the geometric model as the geometry undergoes a design transition based on global model and designer parameters (i.e. performance criterion). (Page 445, paragraphs 1-4, Figure 4)

Cox mentions, but does not explicitly disclose optimizing the model geometry to the performance criterion.

Pearce discloses a turbine blade (bucket) cooling model that includes the effect of cooling passages on the overall design parameters. (Figure 1, Tables II & III) More importantly, Pearce discloses methods for optimization (using well-known fuzzy logic) of

the design parameters (i.e. an optimizer) by comparing performance criterion (page 536, paragraphs 2-4, 6-8), based on model (page 537, paragraph 4) and experimental observations, to established parameter sets and constraints. (page 539, paragraph 1) Pearce also discloses an automatic optimization process. (page 536, Section II, paragraph 6)

It would have been obvious to one having ordinary skill in the art at the time the claimed invention was made to modify the teachings of Cox relating to finite element modeling of geometric properties and a meshed simulation model including coupling conditions, constraint conditions, variables, and boundary conditions of a modeled turbine blade, with the teachings of Pearce relating to the optimization of turbine blade cooling design parameters, to realize the claimed invention. An obvious motivation exists since, in this case, the Cox reference teaches to the Pearce reference, and the Pearce reference teaches to the Cox reference. Specifically, both Cox and Pearce teach the modeling of the internal cooling of a turbine blade and are used in the same technical arena as noted above. Cox teaches to Pearce because Cox discloses that turbine blade cooling design parameters represented in a finite element model can be automatically optimized (Refined: See Cox page 452, paragraph 2). Pearce teaches to Cox because Pearce specifically discloses the use of optimization methods on a turbine blade cooling model. (See: Pearce page 536, paragraphs 2-4, 6-8, Figure 1, Tables II & III) Further, the level of skill required by an artisan to realize the claimed limitations of the present invention is clearly established by both references. (See: Cox/Pearce, Abstracts) Accordingly, a skilled artisan having access to the teachings of Cox and

Pearce, would have knowingly modified the teachings of Cox with the teachings of Peace (or visa versa) to realize the claimed elements of the present invention.

7. Dependent claims 2-10 and 12-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over "Domain Composition Method for Associating Geometric Modeling with Finite Element Modeling", J.J. Cox et al, ACM 089791-427-9/91/0006/0443, ACM 1991 in view of "Use of Fuzzy Logic to Describe Constraints Derived From Engineering Judgment in genetic Algorithms", R. Pearce et al, IEEE Transactions on Industrial Electronics Vol. 43, No. 5, October 1996 and in further view of ANSYS/Professional, Release 5.7, ANSYS Inc., May 2000.

Dependent claims 2-10 and 12-15 are drawn to:

- finite element analysis module and mesh generator, internal/external geometry of bucket (blade) model
- boundary condition processor defining simulated turbine thermal environment outputting model geometry
- control server operating with simulation module, optimizer, and boundary condition processor for FEM bucket model
- agents calculating geometric properties cooperating with simulation module/optimizer creating mesh geometry for bucket model
- controller on computer network coordinating the simulation module and optimizer.

Regarding dependent claims 2-10 and 12-15: As previously cited above, the limitations of independent claims 1 and 11 are rendered obvious in view of the teachings of Cox and Pearce relating to finite element modeling of geometric properties and a meshed turbine blade cooling simulation model including coupling conditions, constraint conditions, variables, boundary conditions, and optimization.

Per dependent claims 2-7, 12-13: ANSYS 5.7 discloses a commercially available finite element modeling platform suitable for use as the claimed finite element analysis module, mesh generator, and geometry processor. (ANSYS: pages 1A-3A) Applicants have admitted that ANSYS is prior art (see specification page 11) and have indicated that the software is appropriate for use as the finite element analysis module and for performing thermal analysis. (Boundary condition (processor) thermal analysis software (SIESTA) is also admitted prior art, See: page 12, paragraph 2) Dependent claims are therefore obvious in view of the ANSYS and SIESTA prior art software.

Per dependent claims 8, 9, and 15: These claims include limitations relating to the use of agents in "cooperating with the simulation module and the optimizer" and controlling calculation of geometric properties. Agents are well known in the art as programs that perform background tasks and report back when the task is done or some expected event has taken place (Microsoft Computer Dictionary, third edition, 1997) and hence would have been an obvious design choice used by one skilled in the art to implement the "cooperation" and "calculation" processes. Since these claims also stand rejected under 35 USC 112(1) and 112(2) paragraph, the examiner has interpreted the claimed "agent" in light of the definition recited above.

Per dependent claims 10 and 14: ANSYS includes networking capabilities and graphics (GUI) processing. (ANSYS: pages 4A, 16-19)

Accordingly, and skilled artisan would have been motivated and knowingly modified the teachings of Cox to include the claimed limitations of dependent claims 2-10 and 12-15 using the same reasoning as previously noted above.

Allowable Subject Matter

8. Claims 16-29 are allowable over the prior art of record.

The following is a statement of reasons for the indication of allowable subject matter: Applicants are disclosing a computer implemented method for optimizing a radial cooled bucket (turbine blade) configuration using finite element analysis, simulation, and optimization of baseline criterion. These features are disclosed in the prior art of record. However, the prior art of record, while disclosing these features does not meet the conditions as suggested in MPEP section 2132, namely:

"The identical invention must be shown in as complete detail as is contained in the ... claim." Richardson v. Suzuki Motor Co., 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). The elements must be arranged as required by the claim, but this is not an ***ipsissimis verbis*** *test, i.e., identity of terminology is not required.* ***In re Bond****, 910 F.2d 831, 15 USPQ2d 1566 (Fed. Cir. 1990)."*

Regarding claims 22-29: In this case, the prior art of record does not disclose the specific sequence of steps and arrangement of elements relating to the radial cooled bucket model's internal/external finite element geometry data, mapping of internal/external boundary conditions to finite element geometry (finite element mesh), simulating (heat transfer analysis) a predicted response on the model with set of internal/external boundary conditions (finite element mesh), optimizing internal geometry by predicted physical response to baseline, modifying the geometry of the model and boundary conditions, and outputting the optimum radial cooled bucket

design data as recited in independent claims 16, 22, and 27-29 and disclosed in applicant's specification pages 14-21, Figs. 1-3, in the context of the claims. Claims 17-21 and 23-26 are allowable as being dependent from independent claims 16 and 22 respectively.

Regarding claims 16-21: Claims 16-21 use "means for" language and are given deference in view of In re Donaldson and interpreted in view of 35 U.S.C. § 112 paragraph 6. The "means for" language and the limitations related thereto of claims 16-21 are interpreted within the scope of enablement as provided within the relative embodiment provided within applicant's specification. Specifically, independent claim 16 recites a system and "means for" model generation of internal cooling bucket geometry, simulating a turbine engine thermal environment and modeling predicted bucket performance parameters, and means for optimizing and outputting the bucket internal cooling model geometry parameters relative to baseline parameters. The examiner has therefore interpreted the "means for" as the specific sequence of steps disclosed within the embodiment of applicant's specification on pages 14-21 and Figs. 2-3 in distinguishing the claimed invention over the prior art of record. Claims 17-21 are allowable as being dependent from independent claim 16.

The closest prior art uncovered during examination discloses elements of the claimed invention as follows:

ANSYS Release 5.7, ANSYS Inc., May 2000: Discloses finite element simulation including thermal, geometric, boundary, and mesh modeling.

"ProFES Probabilistic Finite Element System – Bringing Probabilistic Mechanics to the Desktop", M.A. Cesare et al, American Institute of Aeronautics and Astronautics, AIAA 99-1607, AIAA 1999: Discloses CAD based finite element analysis of turbine engine blade using a finite element model to analyze high cycle fatigue.

U.S. Patent 5,868,194 issued to Horwood: Discloses turbine blade modeling using CAD based optimization of design attributes.

U.S. Patent 6,633,788 issued to Riley et al: Discloses optimizing turbine engine component design including modeling turbine blade (bucket) attribute data (Fig. 22).

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure, careful consideration should be given prior to applicant's response to this Office Action.

"Contribution of Heat Transfer to Turbine Blades and Vanes for High Temperature Industrial Gas Turbines", K. Takeishi et al, Mitsubishi Heavy Industries Ltd., 6 September 2000 teaches turbine blade thermal modeling.

U.S. Patent 6,633,788 issued to Riley et al teaches optimizing turbine engine component design including modeling turbine blade (bucket) attribute data.

U.S. Patent 5,868,194 issued to Horwood teaches turbine blade modeling using CAD based optimization of design attributes.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Fred Ferris whose telephone number is 703-305-9670 and whose normal working hours are 8:30am to 5:00pm Monday to Friday. Any inquiry of a general nature relating to the status of this application should be directed to the group receptionist whose telephone number is 703-305-3900.

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